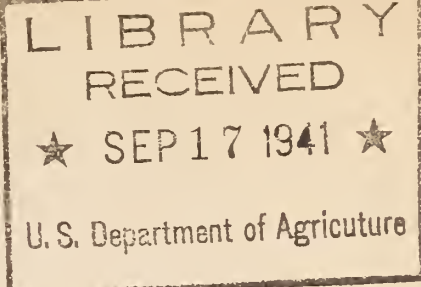


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UNITED STATES DEPARTMENT OF AGRICULTURE
U.S. Agricultural Marketing Service



The Effect of Weather on the Relative Development of Oil and Protein in Cottonseed

By G. S. Meloy, Senior Marketing Specialist

Address, Meeting of Valley Division, National Cottonseed Products Association,
Hot Springs, Ark., April 21, 1941

Mr. President, and
Members of the Valley Division:

It has been repeatedly stated that there is an inverse ratio between oil and protein content of cottonseed. Only a few months ago in a report, which is widely circulated in the cottonseed industry, this statement appeared: "Cottonseed now coming in is low in oil and therefore high in protein."

It is difficult to reconcile oneself to the acceptance of this as an unqualified dictum: First, because it is known that the synthesis of oil in cottonseed is brought about by special agencies which differ from the agencies that bring about the synthesis of protein. Moreover, these different agencies are influenced in their activities by entirely different factors.

Through your cooperation you have enabled me to study the oil and protein development of cottonseed grown in various parts of the country and under almost every possible combination of rain and sunshine and soil condition. I have seen different lots of seed grown in a single county and harvested in the same month, that have identical oil contents but vary in protein contents from 18.75 percent to 21.25 percent, or from 17.53 percent to 21.13 percent; or, on the other hand, seed that have more than 20 percent oil in combination with more than 20.06 percent protein contrasted with seed that have less than 19.0 percent of oil in combination with only 17.50 percent protein. Such combinations indicate that the relation between oil and protein in cottonseed is not always in an inverse ratio.

For the purposes of these studies I have taken the grade certificates issued during August, September, October, and November 1938, covering cottonseed marketed in those months which were grown in Sunflower County, Miss.

Although the oil content of seed grown in Sunflower County during those months varied from 16.7 percent to 22.4 percent, the bulk of the samples was found to range in oil content from 18.3 percent to 20.9 percent. These reports, of which there were 1,229, were first separated according to months and then arrayed according to an increasing sequence of oil content from 18.3 percent to 20.9 percent; after which a study was made of the protein content of the different lots of seed having identical oil contents. The accompanying table shows the study in detail, both by identical oil contents and by groups of oil contents.

First, let us consider some of the variations in the protein content between different lots of seed having identical oil contents. Note that during September, seed with 18.6 percent oil varied in protein, in terms of ammonia, from 3.57 to 4.07 percent; that seed with 19.6 percent of oil varied from 3.41 percent to 4.11 percent in ammonia, and that in seed with 20.6 percent oil, the ammonia was found to range from 3.44 percent to 3.84 percent. During October, seed with 19.0 percent oil ranged from 3.65 percent to 4.25 percent ammonia, and seed with 20.0 percent of oil ranged in ammonia content from 3.61 to 4.03 percent.

Now let us look at samples marketed during different months and see how their average protein contents compare. Compare the September lots with 18.6 percent oil and an average of 3.74 percent ammonia with the October lots with 19.6 percent oil and an average of 3.84 percent ammonia and with the lots marketed in November containing 20.6 percent of oil and an average of 3.91 percent ammonia.

Then let us see what the monthly change in the average protein may be in different lots of seed having identical oil contents; for instance, let's follow the samples found with 19.5 percent oil from August through November. During August, these samples averaged 3.54 percent ammonia; during September, 3.69 percent; during October, 3.85 percent; and during November, 3.88 percent.

Then let us look at the average ammonia in a group of seed containing from 19.0 percent to 19.9 percent oil. During August this group averaged 3.63 percent ammonia; during September, 3.68 percent; during October, 3.84 percent; and during November, 3.86 percent ammonia.

During October the several group averages did appear to be in a sort of inverse ratio, the 18.3--18.9-percent oil group having an average of 3.86 percent ammonia; the 19.0--19.9-percent group, an ammonia average of 3.84 percent; and the 20.0--20.9-percent group, an average of 3.80 percent of ammonia; but the average ammonia in the 20.0--20.9-percent oil group during both October and November was higher than the average ammonia in any of the groups during either August or September.

You will note that in each of the oil groups, as the season progressed, the average ammonia content increased. In the 18.3--18.9-percent oil group, from 3.73 percent in August and September to 3.86 percent in October and November. In the 19.0--19.9-percent oil group, from 3.63 percent in August to 3.68 percent in September, 3.84 percent in October, and 3.86 percent in November. In the 20.0--20.9-percent group, from 3.64 percent in August to 3.66 percent in September and to 3.80 percent in October and November.

From these figures it is apparent that there is very little to that inverse ratio of oil to protein.

Now let us see what the weatherman reported on the weather in Sunflower County, Miss., during each of the months from June to October of that year.

His reports show that during June it rained on 11 days and 4.36 inches of water fell; the sun shone on 11 days. During July it rained on 10 days and 9.10 inches of water were deposited on the soil; the sun shone on only 8 days. The bolls picked in August were growing and maturing in June and July; during those 2 months there was plenty of soil moisture but a minimum of sunshine; and so August seed averaged 20.01 percent oil and 3.64 percent ammonia.

The weatherman reported rain on 3 days during August during which 0.35 inches fell and the sun shone during 13 days, but it was cloudy or partly cloudy during 18 days. The cotton bolls that were harvested during September were growing and maturing during July and August. The dry August lessened the oil development a little. But the cloudy weather did not stimulate protein development, and so the average oil in the seed harvested in September dropped to 19.81 percent, but the ammonia rose only from 3.64 percent to 3.66 percent.

The weatherman reported again, that during September a few showers occurred on 4 days with a total of 0.27 of an inch, and the sun shone not on 19 days and a few clouds passed over on 11 days.

The seed harvested in October were growing and maturing during those hot, clear days of August and September. Still there appeared to be fair soil moisture, for the average oil content dropped only to 19.56 percent. But those clear, sunshiny days pushed the average ammonia up to 3.83.

The seed harvested in November were developing and maturing during September and October. In October the weatherman reported that a total of 1.05 inches of rain fell on 3 days. It was cloudy on 1 day and the sun was hot and bright on 24 days. A few clouds passed over on the other 2 days of the month. What of the seed harvested during November? In the oil group

18.0--18.9, the average oil content rose from 18.62 percent in August to 18.69 percent in November, but the rise in the average ammonia was relatively greater. It rose from 3.73 percent in August to 3.86 percent in November. In the 19.0--19.9-percent oil group the average oil content dropped from 19.66 percent in August to 19.40 percent in November. At the same time the average ammonia rose from 3.63 percent in August to 3.86 percent in November. In the oil group 20.0 percent to 20.9 percent, the average oil content dropped from 20.42 percent in August to 20.24 percent in November while the ammonia rose from 3.64 percent in August to 3.80 percent in November.

To my mind these data indicate that, first, the synthesis of oil in cottonseed is directly affected by soil moisture during the period of maturation of the bolls, and second, that the synthesis of protein in cottonseed is directly affected by the amount and intensity of the sunshine during the period of maturation of the bolls.

So it is not surprising to find cottonseed high in oil content wherever it is grown on soil so tilled as to conserve the moisture, so blessed by nature as to have an ample supply of moisture furnished from the clouds, or so irrigated by man as to have a sufficient supply of moisture by this means and therefore enough moisture within the plant juices for the full synthesis of the oil. Neither is it surprising to find cottonseed high in protein content whenever grown under clear skies and in the presence of a bright sun. It would be a surprise indeed if the seed grown under irrigation in the full sunshine of the Southwest was not high in both oil and protein.

I have seen analyses of seed grown under irrigation in that section of the Southwest, where hotels offer free accommodations any day that the sun does not shine and where the growers have learned the art of irrigating cotton, in which seed the oil content was above 20 percent and the ammonia above 4.20 percent.

It seems safe to predict that whenever such a combination of soil moisture and sunshine occurs as it did in Sunflower County, Miss., during the summer and fall of 1938, cottonseed produced under such conditions will be not only high in oil content, but high in protein content as well, and, further that the oil will be of premium quality.

Oil	August			September			October			November				
	No. of samples	Ammonia		No. of samples	Ammonia		No. of samples	Ammonia		No. of samples	Ammonia			
		Low	High		Average	Low		High	Average		Low	High	Average	
Percent:	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent		
18.3	1	3.71	3.71	3	3.71	3.85	3.77	2	3.82	3.91	3.86	1	3.86	3.86
18.4	1	3.71	3.71	3	3.71	3.93	3.80	3	3.86	3.96	3.83	2	3.83	3.84
18.5	1	3.71	3.71	3	3.71	3.93	3.80	3	3.86	3.96	3.83	2	3.83	3.84
18.6	2	3.40	3.62	6	3.57	4.07	3.74	7	3.70	3.99	3.65	2	3.65	3.79
18.7	1	3.40	3.62	6	3.57	4.07	3.74	7	3.70	3.99	3.65	2	3.65	3.79
18.8	1	3.40	3.62	6	3.57	4.07	3.74	7	3.70	3.99	3.65	2	3.65	3.79
18.9	2	3.81	4.11	8	3.53	3.83	3.70	11	3.75	3.99	3.85	6	3.71	3.95
19.0	1	3.93	3.93	10	3.51	3.88	3.66	23	3.65	4.25	3.89	3	3.75	3.89
19.1	1	3.93	3.93	14	3.53	4.12	3.70	28	3.60	4.04	3.83	12	3.67	4.01
19.2	2	3.63	3.68	16	3.41	4.07	3.68	26	3.68	4.07	3.87	13	3.73	4.01
19.3	1	3.72	3.72	28	3.45	3.99	3.66	26	3.56	4.00	3.85	10	3.73	4.03
19.4	2	3.41	3.54	31	3.31	4.07	3.68	30	3.45	4.08	3.84	6	3.71	4.03
19.5	5	3.23	3.54	29	3.45	3.92	3.69	29	3.71	4.07	3.85	23	3.74	4.05
19.6	6	3.42	3.97	40	3.41	4.11	3.69	46	3.60	4.17	3.84	9	3.60	3.94
19.7	3	3.41	3.69	35	3.49	3.94	3.70	33	3.61	4.10	3.83	6	3.76	4.05
19.8	11	3.40	3.92	44	3.46	3.97	3.67	42	3.47	3.97	3.80	2	3.78	4.05
19.9	7	3.51	3.92	40	3.41	3.94	3.65	28	3.67	4.07	3.83	5	3.70	4.03
20.0	6	3.35	3.74	36	3.52	3.90	3.68	26	3.61	4.03	3.80	2	3.79	4.03
20.1	4	3.59	3.88	40	3.43	3.91	3.66	23	3.43	3.97	3.79	2	3.56	3.95
20.2	4	3.52	3.73	40	3.43	3.84	3.65	15	3.68	3.99	3.83	2	3.65	3.82
20.3	10	3.46	3.95	40	3.51	3.98	3.69	7	3.64	3.98	3.76	1	3.81	3.81
20.4	6	3.53	3.76	31	3.46	3.91	3.66	6	3.71	3.94	3.83	1	3.81	3.81
20.5	2	3.57	3.73	15	3.60	3.80	3.69	4	3.74	3.87	3.82	1	3.81	3.81
20.6	9	3.46	3.72	19	3.44	3.84	3.62	1	3.74	3.87	3.82	1	3.81	3.81
20.7	6	3.36	3.76	9	3.54	3.84	3.66	3	3.76	3.88	3.81	1	3.91	3.91
20.8	5	3.53	3.71	7	3.38	3.80	3.63	3						

August				September				October				November			
Average:		No. of		Average:		No. of		Average:		No. of		Average:		No. of	
Oil	Percent	Low	High	Oil	Percent	Low	High	Oil	Percent	Low	High	Oil	Percent	Low	High
18.62	6	3.40	4.11	17.73	39	3.53	4.07	18.70	41	3.59	4.04	18.69	21	3.55	4.04
19.66	33	3.23	3.97	16.63	287	3.31	4.12	19.49	311	3.45	4.25	19.40	89	3.60	4.05
20.42	54	3.35	3.95	16.64	244	3.38	3.98	20.30	244	3.66	4.03	20.24	9	3.56	3.95
20.01	98	3.23	4.11	16.64	570	3.31	4.12	19.81	442	3.67	4.25	19.35	119	3.56	4.05

